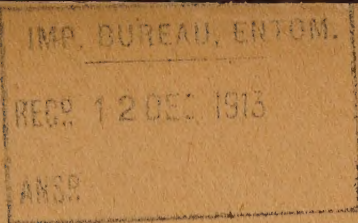


Smith R I

DUPLICATE.



GEORGIA

State Board of Entomology

BULLETIN No. 18.—DECEMBER, 1905.

PEAR BLIGHT DISEASE

Cause and Prevention

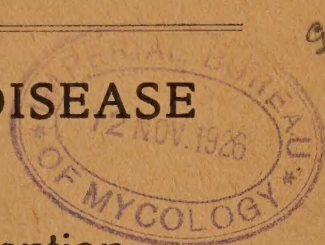
PEAR LEAF BLIGHT



CAPITOL
BUILDING

Atlanta, Ga.

ATLANTA, GA.:
BYRD PRINTING COMPANY,
1906.



GEORGIA

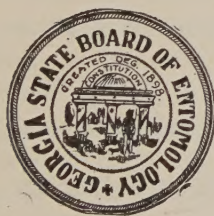
State Board of Entomology

BULLETIN No. 18.—DECEMBER, 1905.

PEAR BLIGHT DISEASE

Cause and Prevention

PEAR LEAF BLIGHT



CAPITOL
BUILDING

Atlanta, Ga.

ATLANTA, GA.,
BYRD PRINTING COMPANY,
1905.

Georgia State Board of Entomology.

ORGANIZATION.

T. G. HUDSON,

Chairman, Commissioner of Agriculture, Atlanta.

P. J. BERKMANS,

President of State Horticultural Society, Augusta.

DUDLEY M. HUGHES,

President of State Agricultural Society, Danville.

R. I. SMITH,

State Entomologist and Secretary of the Board, Atlanta.

A. C. LEWIS,

Assistant State Entomologist, Atlanta,

HARPER DEAN, JR.

Field Assistant Entomologist, Atlanta.

BULLETIN

OF THE

Georgia State Board of Entomology.

DECEMBER, 1905.

No. 18.

Published by the Georgia State Board of Entomology, Atlanta, Ga., and sent free of charge to all residents of the State who make request for same.

PEAR BLIGHT DISEASE IN GEORGIA.

By R. I. SMITH.

Introduction.

Probably every pear grower in Georgia is well acquainted with the familiar appearance of the blight disease, either through actual experience with it in his own orchards, or from observations made in other orchards. Probably no disease of fruit trees is more evident in its effect or more universally known to all fruit growers. But some perhaps do not know that the common pear blight is identical with the blight of apple, quince, hawthorn and other pomaceous fruits. To scientists this fact has, for a number of years, been known, and this information has been given somewhat wide distribution by the United States Department of Agriculture, through the writings of their expert pathologist, Prof. M. B. Waite.

The necessity and value of putting this information in the hands of all fruit growers in Georgia as well as other parts of the South, has made it seem advisable to reprint the known facts regarding the pear blight disease, and the Georgia State Board of Entomology believes this subject to be of sufficient importance to justify its publication as a bulletin of this Department.

We are indebted to Prof. M. B. Waite, Assistant Chief Division of Vegetable Physiology and Pathology, of the United States Department of Agriculture, for the privilege of reprinting his work which is included herewith under the head of, "Cause and Prevention of Pear Blight."

Its Occurrence in Georgia in 1905.

In the spring of 1905 the pear blight caused an unusual amount of injury to both pear and apple orchards in nearly all sections of the State. In some localities the crop was entirely cut off, while in other sections from 50 to 75 per cent of the

blooms were destroyed by the blight bacteria, which caused what is termed "blossom blight." (This form of blight is more fully described farther on.) The writer knows of one case in particular where the annual income from a certain pear orchard has never fallen below \$2,000.00 until this year, when it produced very little over \$100.00 worth of fruit. Some apple orchards also failed for the first time, to produce a good crop of fruit. The unusual weather conditions that prevailed at the time apples and pears were blooming were perhaps favorable to a great increase of pear blight, while at the same time the cold weather caused the death of a certain per cent of the opening blossoms. The two conditions combined were undoubtedly responsible for the failure of the pear and apple crops in certain parts of the State, particularly in North Georgia, but in most parts of South Georgia it seems safe to say that the greater part of the injury was caused by the pear blight without the aid of cold weather.

The fact that the pear blight germ enters principally through the bloom—as described farther on—and that last spring's cold weather came at about the blooming period, was the cause of misleading many growers into the belief that the cold weather was the direct cause of the blight disease, and that without this cold weather very little of the blight would have occurred. This inference, however, was not true, except perhaps to the extent that the heavy frosts and freezes rendered the trees more susceptible, causing a condition favorable to the development of the blight disease. As will be shown farther on, however, the blight bacteria are spread by insects principally, and the blight cannot therefore be directly caused by cold weather, or any condition of the atmosphere.

Pear blight was by no means confined to pear trees during the past season; in fact, as has been mentioned, it was fully as disastrous to apples in some sections. Many apple orchards in North and Middle Georgia put on a heavy bloom and gave promise of an excellent crop. At about the time when the petals should have fallen a heavy frost caused some injury, and at about the same time the blossoms were attacked by the blight bacteria with a result that the majority were destroyed. In some sections that the writer visited the entire injury was supposed to be due to unseasonable frosts and continued cold weather, though a careful examination showed unmistakable evidence of the blight disease. This conclusion was in part justified by the fact that trees without bloom did not show dead

twigs, whereas on other trees every twig, bearing a bloom, was killed back from two to ten inches. Cold weather might well be held responsible for the death of many blooms but it could hardly be expected to kill the twig back of the bloom.

What Can Georgia Growers do to Prevent Pear Blight?

This is the question always asked, and one which arises usually after the damage—for the current year at least—has been done. In reply to such questions we must for the present refer those interested to the latter part of this bulletin in which the cause of pear blight is outlined together with remedial suggestions.

It has already been demonstrated in Georgia, in a few localities, that pear blight can be reduced or prevented to a great extent. Orchards which have received proper care in the way of pruning and judicious cultivation and fertilization, from the first year after being planted out, have been practically free from the pear blight. The great trouble has been, and will continue to be, that young orchards are planted in the vicinity of old and neglected orchards in which the blight develops each year, constituting veritable incubating points for the development of the blight bacteria, which under favorable conditions are spread to orchards which would otherwise be free. Those orchards in which very little blight has occurred are the ones which are more or less isolated and where re-infection from other orchards is reduced to a minimum. Naturally in localities where the orchards closely adjoin one another the matter of blight control becomes difficult. But even in such localities a systematic and thorough pruning will offer protection in most years. There may be years like the one just past when conditions are such that pear and apple orchards will be seriously affected by blossom blight, even though the trees have been given proper attention. The difficulty in obtaining success in this work lies in getting every orchard in each section properly pruned.

Proposed Work Against Pear Blight.

The value of the pruning method for controlling pear blight must be demonstrated in Georgia before it can be expected that all growers will take up the work. For the purpose of determining just how much good will result by giving pear trees proper pruning for a number of years, and to make this demonstration in such a way that pear and apple growers will get the

full benefit resulting from an actual illustration, the Georgia State Board of Entomology has taken the supervision of the pruning of pear orchards in a few representative localities. Work of a nature similar to what will be undertaken by this Department has been conducted quite successfully by Prof. M. B. Waite of the United States Department of Agriculture. This work has been carried on for three years at Cairo, Ga., and also at a point in North Georgia. In the State of Maryland orchards have been treated in a like manner with gratifying results.

By a special arrangement, whereby this Department will work in co-operation with the United States Department of Agriculture, the orchard at Cairo, Ga., will be under the supervision of a member of the Georgia Department of Entomology. Demonstration work will also be carried on at Smithville, Ga., which is now one of the large pear growing sections of this State, and similar pruning experiments will be undertaken in the western and northern sections of Georgia. It is the intention of this Department to continue the work, that is now being started in each section, for at least three years. In the meantime, before the work is discontinued, all pear growers who are interested in the result, will have an opportunity of visiting and inspecting the work as it progresses. By such an arrangement it is hoped that this work will prove to be of peculiar value to the pear and apple growers of the State.

THE CAUSE AND PREVENTION OF PEAR BLIGHT.

By M. B. WAITE.

“There is probably no disease of fruit trees so thoroughly destructive as pear blight, or fire blight, which attacks pears, apples, and other pomaceous fruits. Some diseases may be more regular in their annual appearance, and more persistent in their attacks on the fruits mentioned, but when it does appear, pear blight heads the list of disastrous maladies. Again, no disease has so completely baffled all attempts to find a satisfactory remedy, and, notwithstanding the great progress made within the last ten years in the treatment of plant diseases by spraying and otherwise, pear blight has until recently continued its depredations unchecked. It is now known, however, that the disease can be checked by simply cutting out the affected parts. This was one of the first methods tried in endeavoring to combat the disease, but came to be generally regarded as worthless. The remedy which will be discussed in this paper is, in a general way, so similar to the old one that at first it may be difficult to see that anything new has been discovered. In the process now proposed, however, there are three vital improvements, namely, the thoroughness and completeness with which the work is carried out, the time when the cutting should be done, and a thorough knowledge of the disease so as to know how to cut.

The method of holding the blight in check was discovered through a careful scientific investigation of the life history of the microbe which causes it. The investigations were carried on in the field and laboratory, and extended over several years. In the short account which follows no attempt will be made to enter into the details of the work, nor to introduce all the evidence to prove the various statements, but simply to give such points as will enable the reader to intelligently carry out the method advocated.

WHAT IS PEAR BLIGHT ?

Pear blight may be defined as a contagious bacterial disease of the pear and allied fruit trees. It attacks and rapidly kills the blossoms, young fruits, and new twig growth, and runs down in the living bark to the larger limbs, and thence to the trunk. While the bacteria themselves rarely kill the leaves, at most only occasionally attacking the stems and midribs of the youngest ones, all the foliage on the blighted branches must of course eventually

die. The leaves usually succumb in from one to two weeks after the branch on which they grow is killed, but remain attached, and are the most striking and prominent feature of the disease. (See Fig. 1.)

The most important parts of the tree killed by the blight are the inner bark and cambium layer of the limbs and trunk. Of course, when the bark of a limb is killed, the whole limb soon dies, but where the limb is simply girdled by the disease, it may send out leaves again the next season and then die. All parts of the tree below the point reached by the blight are healthy, no more injury resulting to the unaffected parts of the tree than if the blighted parts had been killed by fire or girdling.

Blight varies greatly in severity and in the manner in which it attacks the tree. Sometimes it attacks only the blossom clusters or perhaps only the young tips of the growing twigs; sometimes it runs down the main branches and trunk; and again it extends down only a few inches from the point of attack. The sudden collapse of the foliage on blighted branches has led many to believe that the disease progresses more rapidly than it really does. It rarely extends farther than 2 or 3 inches from the point of attack in one day, but occasionally reaches as much as 1 foot.

It is an easy matter to determine when the disease has expended itself on any limb or tree. When it is still progressing, the discolored, blighted portion blends off gradually into the normal bark, but when it has stopped there is a sharp line of demarcation between the diseased and healthy portions.

CAUSE OF THE DISEASE.

Pear blight is caused by a very minute microbe of the class bacteria. This microbe was discovered by Prof. T. J. Burrill, in 1879, and is known to science as *Bacillus amylovorus*. The following are the principal proofs that it causes the disease: (1) The microbes are found in immense numbers in freshly blighted twigs; (2) they can be taken from the affected tree and cultivated in pure cultures, and in this way can be kept for months at a time; (3) by inoculating a suitable healthy tree with these cultures the disease is produced; (4) in a tree so inoculated the microbes are again found in abundance.

LIFE HISTORY OF THE MICROBE.

Blight first appears in spring on the blossoms. About the time the tree is going out of blossom certain flower clusters turn black and dry up as if killed by frost. This blighting of blossoms, or



FIG. 1. PEAR TREE SHOWING LIMBS KILLED BY PEAR BLIGHT. (NOTICE THE LIMBS ON WHICH LEAVES ARE CURLED AND DROOPING.)
Photograph taken May 29, 1905, Summerville, Ga. Photo by R. I. Smith.



FIG. 2. KIEFFER PEAR ORCHARD, FOUR YEARS OLD, SHOWING VASE FORM OF PRUNING
PRACTICED BY M. B. WAITE.
(From Year Book, Dept. of Agr., 1900.)



FIG. 3. MANNING PEAR ORCHARD, SHOWING PYRAMIDAL FORM OF PRUNING.
From Year Book, Dept. of Agr., 1900.

blossom blight, as it is called, is one of the most serious features of pear blight. One of the most remarkable things about this disease is the rapidity with which it spreads through an orchard at blooming time. This peculiarity has thrown much light on the way the microbes travel about, which they do quite readily, notwithstanding the fact that they are surrounded and held together and to the tree by sticky and gummy substances. They are able to live and multiply in the nectar of the blossom, from whence they are carried away by bees and other insects, which visit the blossoms in great numbers for the honey and pollen. If a few early blossoms are infected, the insects will scatter the disease from flower to flower and from tree to tree until it becomes an epidemic in the orchard. We shall see later how the first blossoms are infected. From the blossoms the disease may extend downward into the branches or run in from lateral fruit spurs so as to do a large amount of damage by girdling the limbs. Another way in which the blight gains entrance is through the tips of growing shoots. In the nursery, when trees are not flowering, this is the usual mode of infection. This is often called twig blight, a good term to distinguish it from blossom blight, provided it is understood that they are simply different modes of attack of the same disease.

CONDITIONS AFFECTING THE DISEASE.

The severity of the attacks, that is, the distance which the blight extends down the branches, depends on a number of different conditions, some of which are under the control of the grower. It is well known, however, that the pear and quince are usually attacked oftener than the apple. Some varieties of pears, like Duchess and Keiffer, resist the disease much better than others, such as Bartlett and Clapps Favorite. It may be stated in a general way that the trees most severely injured by the blight are those which are healthy, vigorous, well cultivated and well fed, or, in other words, those that are making rapid growth of new, soft tissues. Climatic conditions greatly influence the disease, warm and moist weather, with frequent showers, favoring it; dry, cool, and sunny weather hindering it; and very dry weather soon checking it entirely.

The pear blight microbe is a very delicate organism and can not withstand drying for any length of time. In the blighted twigs exposed to ordinary weather it dries out in a week or two and dies. It causes the greater part of the damage in the month or two following blossom time, but twig blight may be

prevalent at any time through the summer when new growth is coming out. In the nursery severe attacks often occur through the summer. In the majority of cases, however, the disease stops by the close of the growing season. At that time the line of separation between the live and dead wood is quite marked, and probably not one case in several hundred would be found where the diseased wood blends off into the healthy parts and the blight is still in active progress. In the old, dried bark, where the disease has stopped, the microbes have all died and disappeared.

It has been claimed that the blight microbe lives over winter in the soil, and for a long time the writer supposed this to be the case; but after careful investigation the idea was abandoned, for in no instance could it be found there. Unless the microbes keep on multiplying and extending in the tree, they soon die out. This is a very important point, for it affords opportunity to strike the enemy at a disadvantage. In certain cases the blight keeps up a sort of slow battle with the tree through the summer, so that at the close of the season, when the tree goes into a dormant condition, active blight is still at work in it. This is also true of late summer and autumn infections. In these cases the blight usually continues through the winter. The germs keep alive along the advancing margin of the blighted area, and, although their development is very slow, it is continuous. Probably the individual microbes live longer in winter. At any rate, the infected bark retains its moisture longer, and generally the dead bark contains living microbes during a much longer period than it does in summer. It has already been found that this microbe stands the cold well. Even when grown in broth in a warm room they may be frozen or placed in a temperature of 0° F. and not suffer.

When root pressure begins in early spring the trees are gorged with sap. Under these favorable conditions the microbes which have lived over winter start anew and extend into new bark. The new blight which has developed in winter and spring is easily recognized by the moist and fresh appearance of the blighted bark, as contrasted with the old, dead, and dry bark of the previous summer. The warm and moist weather which usually brings out the blossoms is particularly favorable to the development of the disease. At this time it spreads rapidly, and the gum is exuded copiously from various points in the bark and runs down the tree in a long line. Bees, wasps, and flies are

attracted to this gum and undoubtedly carry the microbes to the blossoms. From these first flowers it is carried to others, and so on till the blossoms are all killed or until the close of the blooming period. Even after the blooming period it is almost certain that insects accidentally carry the blight to the young tips and so are instrumental in causing twig blight also. The key to the whole situation is found in those cases of active blight, (comparatively few), which hold over winter. If they can be found and destroyed, the pear-blight question will be solved, for the reason that without the microbes there can be no blight, no matter how favorable the conditions may be for it; to use a common expression, there will be none left for seed.

TREATMENT FOR PEAR BLIGHT.

The treatment for pear blight may be classed under two general heads: (1) Methods which aim to put the tree in a condition to resist blight or to render it less liable to the disease; and (2) methods for exterminating the microbe itself, which is of first importance, for, if carried out fully, there can be no blight. The methods under the first head must unfortunately be directed more or less to checking the growth of the tree, and therefore are undesirable except in cases where it is thought that the blight will eventually get beyond control in the orchard. Under the head of cultural methods which favor or hinder pear blight, as the case may be, the following are the most important.

Pruning.—Pruning in winter time, or when the tree is dormant, tends to make it grow and form a great deal of new wood, and on that account it favors pear blight. Withholding the pruning knife, therefore, may not otherwise be best for the tree, but it will reduce to some extent its tendency to blight.

Fertilizing.—The better a tree is fed the worse it will fare when attacked by blight. Trees highly manured with barnyard manures and other nitrogenous fertilizers are especially liable to the disease. Overstimulation with fertilizers is to be avoided, especially if the soil is already well supplied.

Cultivation.—The same remarks apply here as in the case of fertilizing. A well-cultivated tree is more inclined to blight than one growing on sod or untilled land, although the latter often do blight badly. Generally good tillage every year is necessary for the full development of the pear and quince trees, and it is more or less so for the apple in many parts of the country; but the

thrift that makes a tree bear good fruit also makes it susceptible to blight. Check the tree by withholding tillage, so that it makes a short growth and bears small fruit, and it will be in better condition to withstand blight than it would were it cultivated. In cases where thrifty orchards are attacked by blight and threatened with destruction, it may often be desirable to plow them once in the spring and harrow soon after the plowing, to plow them only, or to entirely withhold cultivation for a year, mowing the weeds and grass or pasturing with sheep. A good way is to plow the middle of the space between the rows, leaving half the ground untouched.

Irrigation.—In irrigated orchards the grower has the advantage of having control of the water supply. When such orchards are attacked, the proper thing to do is to withhold the water supply or reduce it to the minimum. Only enough should be supplied to keep the leaves green and the wood from shriveling.

Extermination of the blight microbe.—We now come to the only really satisfactory method of controlling pear blight—that is, exterminating the microbe which causes it, by cutting out and burning every particle of blight when the trees are dormant. Not a single case of active blight should be allowed to survive the winter in the orchard or within a half mile or so from it. Every tree of the pome family, including the apple, pear, quince, Siberian crab apple, wild crab apple, the mountain ash, service berry, and all the species of *Cratægus*, or hawthorns, should be examined for this purpose, the blight being the same in all. The orchardist should not stop short of absolute destruction of every case, for a few overlooked may go a long way toward undoing his work. Cutting out the blight may be done at any time in the winter or spring up to the period when growth begins. The best time, however, is undoubtedly in the fall, when the foliage is still on the trees and the contrast between that on the blighted and that on the healthy limbs is so great that it is an easy matter to find all the blight. It is important to cut out blight whenever it is found, even in the growing season. At that time of the year, however, it can not be hoped to make much headway against the disease, as new cases constantly occur which are not sufficiently developed to be seen when the cutting is done. In orchards where there are only a few trees, and the owner has sufficient time to go over them daily, he will be able to save some which would otherwise be lost. However, when the trees stop forming new wood, the campaign should begin in earnest.

In cutting out the blight, great care must always be taken to cut on the healthy wood well below the lowest point discolored by the disease. It is usually safer to cut at least a foot or more on apparently sound wood, although by carefully studying the case it may not be necessary to go so far below.

An important matter in cutting out the blight is to carry along some disinfecting solution with which to sterilize the knife or other tools used. For this purpose any one of the following solutions may be used: Mercuric chloride, or corrosive sublimate, 1 part to 1,000 parts water; 5 per cent carbolic-acid solution; or, a solution of chloride of lime. The first may be best prepared by purchasing tablets of a definite amount at a drug store. These tablets can be kept in a small bottle, and a pint or quart bottle filled with water and one of the tablets added. Upon concluding work the bottle should be emptied to avoid the danger of poisoning children or unsuspecting persons. By this means the danger of using this deadly poison may be avoided. Carbolic-acid solution may be prepared by simply adding a tablespoonful or more to a bottle of water and shaking it up. The saturated solution, which contains about 5 per cent of carbolic acid, is the proper strength to use. A solution of chloride of lime will answer about the same purpose and is made by adding 20 parts of water to 1 part of the commercial chloride of lime, shaking it up and pouring off the clear liquid. This is only fit for use while fresh. Any of these solutions can be carried by the operator, and a strip of cloth a yard or so in length should be fastened to the clothing, leaving one end hanging free. When cutting into active blight, the ends of the cloth may be kept saturated with the disinfectant and the knife sterilized by wiping before using it on the sound wood. *It is also better to wipe off the wound on the sound wood with the saturated cloth, otherwise there will be danger of leaving the blight germs on the cut surface and merely starting the blight over again.* A knife used to cut into blighting tissue becomes subsequently a veritable inoculating instrument, and should always be sterilized before using on healthy tissues.*

Of course, the greater part of the blight can be taken out the first time the trees are gone over. If this be in midsummer, the

*Paragraph extracted from article by M. B. Waite, in *Yearbook Department of Agriculture*, 1900.

trees should all be again carefully inspected in the autumn, just before the leaves shed, so as to get every case that can be seen at that time. After this a careful watch should be kept on the trees, and at least one more careful inspection given in spring before the blossoms open. It would doubtless be well to look the trees over several times during the winter to be certain that the blight is completely exterminated. In order to do the inspecting thoroughly it is necessary to go from tree to tree down the row, or in case of large trees to walk up one side of the row and down the other, as in simply walking through the orchard it is impossible to be certain that every case of blight has been cut out.

The above line of treatment will be even more efficacious in keeping unaffected orchards free from the blight. A careful inspection of all pomaceous trees should be made two or three times during the summer and a sharp lookout kept for the first appearance of the blight. It usually takes two or three years for the disease in an orchard to develop into a serious epidemic, but the early removal of the first cases will prevent this and save a great deal of labor later and many valuable trees.

In doing this work it must be remembered that success can be attained only by the most careful and rigid attention to details. Watch and study the trees, and there is no question that the time thus spent will be amply repaid."

LEAF BLIGHT OF PEAR AND QUINCE.

By R. I. SMITH.

In connection with the discussion of the true pear blight it seems desirable to mention the leaf blight which is entirely distinct from the former disease. Leaf blight is caused by the fungus *Entomosporium maculatum*, while the true pear blight is caused by a bacteria or germ. Pear twigs attacked by true pear blight show curled and blackened leaves—this feature being very prominent, (see Fig. 1)—but usually the leaves themselves are not killed by the pear blight disease, but die as a necessary consequence, following the death of the twig to which they are attached.

Leaf blight is one of the most serious diseases of the pear, and is also frequently abundant on the quince. The blight first develops soon after the leaves become fully expanded in spring, appearing first as minute reddish spots on the upper surface of the leaves; these spots soon enlarge and penetrate to the lower surface of the leaves. As they increase in size and numbers considerable areas of the leaves may become involved by the fungus itself while the areas in between the spots become greatly weakened. The reddish spots soon change to a deep brown with dark center, finally becoming nearly black. With a magnifying glass minute black dots may be discovered in the center of the spots, these dots being the fruit or spores of the fungus. When leaves are badly affected it results in severe shedding, so that the pear trees often appear as bare in mid-summer as they normally would in winter. Almost complete defoliation is frequently encountered in the pear orchards in South Georgia. This of course results in great injury to the trees which are prevented from storing up materials of growth necessary for their continued health and development.

Unfortunately leaf blight is by no means confined to the leaves but appears on both twigs and fruit. The former are attacked much the same as the leaves. The fruit first becomes covered with reddish pimples, soon changing to nearly black, while the diseased tissue begins to crack in such a manner as to ruin the fruit. Even when pears attain full size, the cracking may be so severe that the fruit will be unsalable.

Hot, dry weather seems to be favorable to an increase of pear leaf blight, though the disease is liable to develop almost every season. When young tender leaves are attacked the result is that

they become curled, due to a contraction of the diseased areas. Full grown leaves usually retain their shape even when completely covered by black spots.

One result of severe defoliation is that pear trees are forced into a second growth if weather conditions are at all favorable, and frequently the second growth of leaves are attacked and destroyed by the fungus. This lack of foliage in middle and late summer is almost sure to induce many fruit buds to open late in the fall, thereby decreasing the chances for a crop the following year. Pear orchards in South Georgia are sometimes white with bloom during the latter part of October, and not infrequently small fruit is developed.

Remedy for the Leaf Blight.

Experiments have shown that the leaf blight is readily controlled by the proper use of Bordeaux mixture. Early spraying, before the leaf buds expand, is not necessary in controlling this disease, though for many other troubles the early spraying is advisable. One thorough spraying with Bordeaux as soon as the trees are in full foliage—about two to four weeks after the blossoms fall, according to M. B. Waite,* and a second application two weeks later, is usually sufficient to control the disease for the season. On rapidly growing nursery stock it is often necessary to spray five and six times to keep the new foliage covered as fast as it appears. For adult pear trees Bordeaux mixture at the rate of 4 pounds of blue stone (copper sulphate), to 6 pounds lime in 50 gallons of water should be the strength employed. For nursery stock it would be well to use a weaker strength.

**Yearbook, Department of Agriculture*, 1900, p. 389.

